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The Lighting of Architecture*

By G. GRENFELL BAINES, A.R.I.B.A., A.M.T.P.I.

Synopsis

The time is now opportune for a better appreciation of the work of lighting engineers and architects in view of the importance of recent lighting developments. The paper deals with the essential characteristics of, and differences between, architecture before and since the advent of modern artificial light sources.

A warning is given against attempting to attain by means of artificial lighting the effects produced by sunlight, and the paper considers the uses of various methods of illumination.

Consideration is also given to the question of lighting and decoration and the proper use of lighting fittings in order to give pleasing effects.

The paper concludes with some views on future possibilities, and stresses the need for co-operation between the architect and the lighting engineer.

Introduction

Our forefathers—those simple people who rose with the sun, more or less, and went to bed with it "rather less than more"—saw their buildings, inside and out, almost wholly by natural light, and designed them solely with this in view, but when these children of nature first saw and realised the powerful possibilities of artificial light they exclaimed, and believed, that man could now turn night into day.

They were over-anticipating, for since those early days all the efforts of man seem to have succeeded not only in turning night more firmly into night, but in darkening day itself with a foreboding shadow of night.

Lighting engineers, often incited though perhaps not aided by architects, may be forgiven, and even commended, for the former, but the latter is a quite inexcusable crime. Not possibly a direct crime against their fellow man, but certainly a crime against architecture and therefore one not far removed.

Having by now aroused your interest and critical faculties, it is proposed to confine this paper as closely as possible to architectural matters, the aim being to reveal the architect's attitude to the design of buildings as an indispensable ingredient of visual appreciation, the full realisation of which can contribute so much to the good life.

Definition of Architecture

For the purpose of this lecture, Architecture may be defined as the confining of space in certain forms by certain surfaces to afford graceful shelter for some human activity. Grace is essential.

Illuminating engineers, it is assumed, are more concerned with the interiors of buildings, though something will be said about exteriors, which

* Manuscript received on November 18, 1947. Presented at a meeting of the Society on February 10, 1948.

are in turn the interiors of towns, a point of some significance in the light of new town developments and the increasing awareness of town design.

These space-confining surfaces may be themselves defined and enriched by members at their junctions, as cornices and friezes, or on their surface as surrounds to openings or enrichments of necessary structural projections like beams, pillars, and trusses. This is particularly noticeable in past styles where materials and technique made incidence an essential by-product of the act of building.

Modern developments in building technique and a more functional view of the purpose of architecture have together brought about a revolution in architectural form, characterised by broader, simpler surfaces more closely related to the outside by large windows, with more open and fluid interior effects due largely to the greater use of glass, freedom from columns and piers, and the many incidences that earlier mass construction demanded.

One further feature of modern architecture, more often than not arising from the need to economise in a Society where expanding population and diversion of labour from basic activities together reduce building resources, is that rooms and apartments are much lower than they used to be. This is justifiable not only in view of the heightened spatial effects previously mentioned, but because of the need for fuel economy and better acoustics. It is also in tune with the changing attitude to architectural effect which tends to reduce the monumentality of the building and emphasise the importance of the human user.

To sum up, the essential difference between old and new architectural style is that the classic interiors were almost always designed as ends in themselves; within them the people were but foils to their own achievements. On the contrary, most modern interiors are designed to serve as backgrounds to the activities of their users, together with their furniture, and artificial lighting, heating, and ventilation elements.

Neglecting the inevitable time lag in human affairs between inventions and their fully worked out implications, "classic architecture" may be said to belong to the period before the electric lamp became popular, and "modern architecture" should have come immediately after it. That it is looming here —seventy years after Edison's and Swan's first lamps—is an eloquent commentary on British grit.

Lighting Effects

To-day light has to be applied to both the legacy of the past and the products of the present—architecture originally designed and used by people whose only significant source of light was the sun—and architecture designed to be used and seen at all hours of the day and night; an established way of living to which more attention has yet to be paid.

It is well known that the successful revelation of architectural form, particularly by natural light, is as much dependent on shade as light. Such crowning features as friezes and cornices only succeed in serving their dual function of defining and enriching the surface on which they occur if they are able to show a strong shadow or succession of shadow lines. It is this succession of shadow lines, with graduation to and from light, which gives mouldings their character and effect, whether they be part of an assembly which marks out the full limits of a surface, such as an entablature or skirting, or the boundaries of an element in the surface such as door, window or panel.

The significance of an opening depends as much on the shadow of reveals and soffits as on the richness of the moulds surrounding it or the lighted reveal.

Lighted reveals and soffits can, however, provide striking emphasis to an opening the importance of which merits special attention. However, only artificial light can bring about complete illumination of both reveals and soffits of an opening owing to sunlighting being generally of a uni-directional character. This is probably a good point at which to study the effects of sunlight in order to gain inspiration for artificial lighting designs.

Imitation of anything is a confession of design failure, and slavish imitation of sunlight effects—even if one were willing to waste the power—would in any lighting scheme only produce sterile results, just as the attempts of electric fire designers to reproduce coal and flickering firelight have resulted in obvious shams unworthy of serious attention.

Nevertheless, certain characteristics of sunlight do serve as criteria to be aimed at in a lighting scheme. The two principal characteristics of sunlight are diffusion, which in no way tends to destroy surface character, and directional lighting, which provides strong shadows with the beneficial effects already mentioned; the former is produced by indirect and the latter by direct lighting.

A third advantage, which will be referred to later, is that sunlight illuminates without producing any interference with the spatial quality of a room. On most days the sun provides, even indirectly, a high level of light, and strong variations such as slanting beams through high spaces, and brilliantly illuminated patterns on floor and wall surfaces can be accepted and enjoyed particularly in passing, say, through a cathedral or down a wide corridor. Thus variety is another aspect worth consideration, but should not be

Fig. 1. Example of ceiling light scheme the result of which is unpleasant heaviness in the appearance of the ceiling and disturbing contrasts between lighted and unlighted surfaces.

used universally. The prevalence of venetian and sun blinds, even in Britain, shows a native desire for smoothing out the strong contrasts of direct sunlighting thus restoring the diffusive effect. While it may be argued that this is less on account of aesthetic than physical considerations affecting vision, architects are concerned as much with the comfort and convenience as with the aesthetics of their works and, indeed, they believe that proper attention to the physical requirements of users can bring a material contribution to appearance, provided it is not overdone.

Diffused lighting, direct unidirectional lighting, variety and non-interference with spatial characteristics are four useful aspects of sunlighting to carry forward. What should not be carried forward is the imitation window or roof light effect, resulting in the creation of illuminated wall or ceiling panels denying artificial lighting its own expression, to which it has an unquestionable right. Though not viewed with favour, perhaps, all ceiling lights ought not to be condemned.

The premises on which disapproval is based are:—during the day the window is a welcome hole in the wall; it admits daylight, offers escape to the gaze, and often the concentration, of the occupier, but at night, generally, there is little to be seen through the window and very little light, if any, coming through it. On the other hand, for a large part of the year in Britain much heat goes out through it.

In any event the window is an emblem of day. Glass, particularly at night, is an uncomfortable, cold and shiny material. What is necessary at night is warmth with a strong sense of enclosure; appropriately we draw our curtains and blinds and those children of nature before us, being even more sensible, provided themselves with heavy wooden shutters as well.

Having thus excluded the outside effect of the window, achieving in so doing a desirable sense of enclosure, why should any sane person wish to open up the whole matter once more by creating another window with its

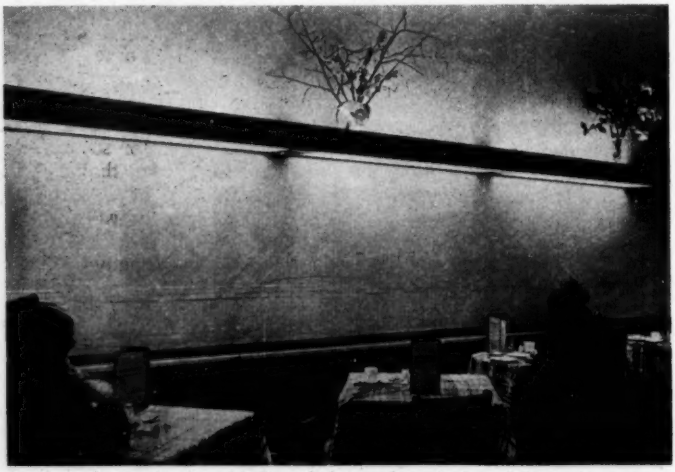

Fig. 2. A good example of semi-indirect lighting where design of fitting is an important element in the architectural composition.

cold glass surface, having no view worth speaking about, and producing an effect (with the greatest respect) as dead as a glass eye.

Such panels, furthermore, would invariably be additional to doors and normal windows, resulting in further infringements on wall and ceiling surfaces, and giving the designer additional complications with which to cope. They would be there all the time, day and night, substantial evidence of the unforgivable crime—hanging statuettes and baskets of flowers before them being but irrelevant embellishments of a quite unconvincing story.

Having reviewed those characteristics of sunlight which might be appropriate to artificial lighting, we can now consider them in detail in conjunction with the distribution of light.

Distribution of Light

From the rush light up to the fluorescent tube, or its painfully contrived equivalents, the architectural strip or the row of bulbs in a trough reflector, our night light is characterised by its point source. The point could be augmented by other points to make a constellation, or fused into a line by reflectors, or it could be enlarged by semi- or totally-enclosed white opal glass fittings.

The chief thing to remember is that the point, large or small, bright or less intense, calls essentially for the direct lighting approach.

The definition of direct and indirect lighting in the sense used in this paper, together with that of some grounds which lie between these two boundaries, may now be given. Indirect lighting is represented by whole wall, ceiling or other surface which reflects light projected on to it from a totally concealed source. Direct is the reverse, the source being visible, the wall and ceiling wholly or partly receiving light dependent on the design of the fitting. Between these two we get semi-direct distributions in which the fittings may wholly or partly conceal the light source.

Completely indirect lighting involves no infringement of spatial qualities, but it may give certain construction troubles and from a strictly economic point of view is inefficient. Direct lighting, on the other hand, is responsible for more sins against space than any other unnecessary bric-à-brac. To this must be added, more often than not, the offence of crudity; it is, however, the most economical. The semi-direct method, distinguished by fittings fixed to wall and ceiling surfaces, has produced some of the most successful lighting schemes having the least deleterious effects on architectural space or surface. It is in this field, to some extent a combination of the other two, that the designer should find a greater number of happy solutions to most of the problems presented by modest-sized apartments, whether in old or new work.

The great advantage of non-infringement offered by indirect lighting, particularly in these days of more restricted space, is attractive to architects. Again, the thought that a whole wall or ceiling may become a built-in diffuser is in line with contemporary ideas, even though the reflector may be profiled with molds, pilasters and cornices. It has been observed, however, that while really successful indirect schemes may look well on photographs they tend to be cold to live in; this applies to schemes designed so that whole surfaces receive complete illumination, and the cold look probably arises from this uniformity. Part of the charm of a semi-direct scheme is its variety of light and shade, but in this connection attention must be drawn to the need for maintenance of surface character. By this is meant that the patterns of light and shade and the definitions of their boundaries should in no way ever be

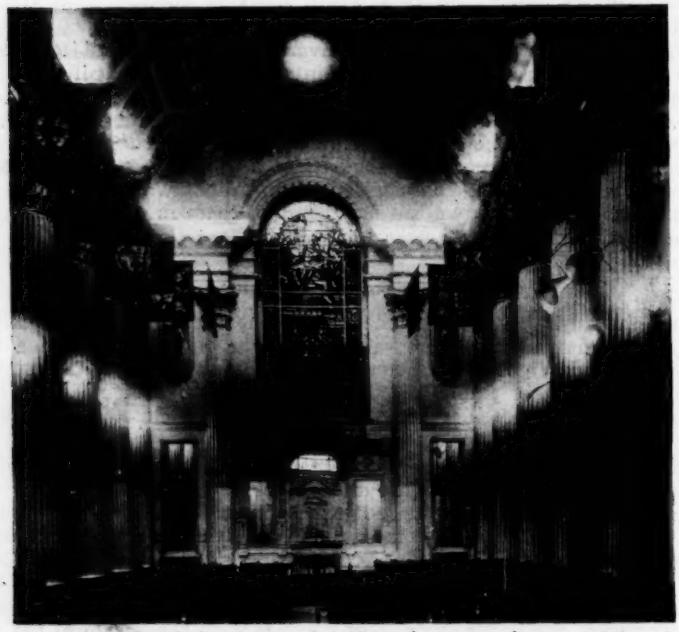

Fig. 3. An example of destruction of surface character and structural form by an artificial lighting scheme.

allowed to detract from the original shape of the wall or ceiling. The direct type bowl or shade fitting which throws a hard curved shadow cutting off the head of the wall, and more often than not amputating the corners of the ceiling, is about the best example of surface character destruction.

If a scheme is to meet the demands of variety by offering alternate areas of light and shadow, then the shapes and proportions of lighted and shadowed surfaces must be carefully balanced in relation to each other and to the main shape on which they occur. There is no reason why night lighting should not introduce attractive new shadow shapes on wall surfaces just as flickering fire-light does. An amazingly voluptuous effect on a ceiling of a high room was recently achieved by covering a bare lamp with a ruched reading lamp shade mounted in an inverted position, with the height so adjusted that the pattern fell nicely within the lines of the cornice at the boundaries of wall and ceilings. In a higher room it would have been possible, by lowering the fitting, to have cast the curved shadows on the walls, lighting the whole of the ceiling and a scalloped frieze on the wall. The room was exactly square and the light source was mounted in the centre, thus maintaining order in the light and shade patterns. In this case, however, the height of the room did not suit the wall and ceiling effect, the apparent height of the wall being too greatly reduced by the lighted frieze and, in any case, the fitting would have been too near head height.

This example shows the importance of light and shade patterns in relation

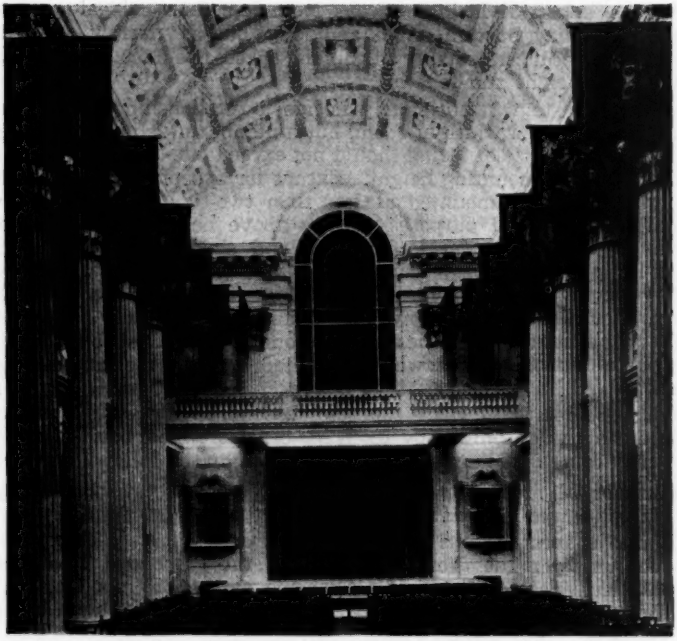

Fig. 4. The interior shown in Fig. 3 with redesigned lighting. Note effect of repose and architectural character.

to the sizes and proportions of the enclosing surfaces. As a general rule, lighted areas should be confined to one surface unless, by generously flowing over wall and ceiling a good lap effect can be obtained. Nothing looks worse than a shadow pattern which occupies part of the wall and some or all of the corners of the ceiling. Lines between lighted and shaded areas are better soft graduated than hard edged, particularly where they occur near the main boundaries such as junctions between walls and ceilings.

The great advantage of sunlight from the point of view of not interfering with spatial qualities has already been mentioned, but the undoubted economic advantages of direct lighting from suspended sources is such that the possibilities of reconciling these utilitarian and aesthetic aspects must be explored.

Lighting Fittings and Decoration

The opening indictment in this paper was made on account of the vast amount of spatial pollution caused by suspended fittings, varying in appearance from nondescript to Chinese lanterns or from simple spheres to miniature classic temples (perhaps the original sources of dim religious light). It must be admitted, however, that there are apartments large enough and fittings sufficiently small for rules of space saturation to be established. The numbers and sizes and shapes of fittings in relation to the size and shape of the space to be lighted must be considered. Size and shape must always be considered jointly,

for example, spherical fittings always loom less than cubical or disc types. An apartment may be quite high and long, but so narrow that anything suspended would uncomfortably fill up the space, even though it might be in scale with the height and length.

Individual taste will ultimately decide a relationship between width of suspended fittings and width of room, but a number of experiments has shown that the maximum size of fitting should not exceed one-tenth of either the least room dimension or mounting height. Except for exceptionally high structures, fittings should not be mounted at less than two-thirds of the room height, and apart from special purposes, always above head height. There seems to be a good case for developing neat and simple telescopic suspensions which will permit of easy height adjustment, allowing, where structure permits, complete recessment of a fitting into roof spaces. Efficiency, however, should never be allowed to dominate completely the question of how the architectural qualities of a room are affected by the day-time appearance of fittings, which when unlighted are of little use and even less ornament.

Having decided that a space can hold suspended fittings, their number, size and shape can be determined by intensity considerations, but while these conclusions may come first they may be conditioned by the following rules:—

1. Number of fittings multiplied by bulk should not exceed saturation factors given earlier.
2. Round shapes cut less into space than any others. This simple fact accounts for the great popularity of the suspended sphere and the attractiveness of the lighting scheme at the Scandia Cinema, Stockholm, where patterns of suspended spheres are used with conspicuous success.
3. The design of suspended fittings should ensure a floating character—spheres and shallow circular bowls looking best, while cubes and discs are less effective. Hanging architectural apparitions of prostituted fluorescent tubes are too static in character to float; they should be on the ground or under it. The "architectural" style is quite inappropriate. Suspended fittings, by employing free curved shapes and lines, should be more in character with soft furnishings. Early chandeliers are good examples.

The means by which many suspended fittings have been enabled to maintain their menacing aspect to space and safety are not on any grounds to be excluded from condemnation. Heavy chains and rods, varicosely enriched, have long conspired to obstruct the view of architectural form and to mute spatial effects. Happily there was pre-war evidence that these obstructions were out of favour with the designers of fittings, simple tubes being used with better effect. Their immediate popularity served to show that, faced with good design, public opinion invariably shows the right reaction. Recently experiments have been made with transparent plastic suspensions. They are most effective, but for obvious reasons their use produces an even stronger need for fitting forms with the floating quality.

Before leaving direct lighting effects mention must be made of the importance of visual, as well as photo-electric, satisfaction. For example, a modern school had two different schemes in adjacent rooms; the first was lighted by spherical diffuser-type fittings with tungsten lamps, and the second by fluorescent tubes within opaque reflectors. The fittings were suspended in both cases, and the walls were painted light cream. In the first room, the light meter

showed 12 foot candles, and in the second 15 foot candles, and yet the apparent brightness in the first room was greatly superior to that of the second. In the first room, wall and ceiling surfaces were bathed in bright light, while those of the second room received a mixture of direct and indirect lighting of varying intensities, and the spatial effect of the upper portion was an unpleasant mixture of brightly glowing reflectors and tubes crowned by canopies of semi-darkness. Despite the evidence of the light meter at the working plane, nine out of ten people would have said that the first room was better lighted than the second, and better to work in.

The conclusion may be drawn, that structural areas receiving light, particularly if of high reflectance, are of greater importance than the manufacturers of opaque reflectors may realise.

Further attention to the proportions of apartments and the adoption of semi-direct schemes often leads to the use of fittings attached to walls and ceilings. Here style and size are affected by different considerations. Walls and ceilings are tangible architectural elements, and may be treated in a formal architectural manner. Such fittings as are attached to them may appropriately take more static architectural forms, while observing the above prescribed rules of size and number in relation to the size of wall or ceiling surface lighted.

It is desirable on ceilings that attached fittings should be so shaped that they hold naturally to the flat surface on which they occur. For this reason completely symmetrical shapes, such as spheres, right up against ceilings seldom look well.

While architectural character may be given to attached fittings, the style of wall fittings in particular may be closely related to furnishing styles. There is not quite the same need for wall fitting shapes to "hold" to the surface; they may float free of the wall while only their brackets hold closely, as exemplified by charming and perfectly satisfying wall brackets with fabric shades. One recent development in the design of attached fittings, more particularly in the case of ceiling types (though there is no reason why the principle should not be employed with wall types) is for the architectural surface itself to be moulded to form an integral part of the fitting. This is a step towards the deliberate moulding of fundamental forms on a basis of night lighting. For example, a fibrous plaster reflector of curved wedge form was inserted into a flat ceiling, moulding the ceiling into the curves, and a trough was then attached below with satisfying architectural and lighting effects.

Such treatment does much to ensure that the lighting is an integral part of the decoration scheme. When considering the colour of a ceiling of this type, it must not be forgotten that it is a reflector for a significant part of its surface. Two possibilities arise here: one, to allow the existence of the reflector to determine the colour of the whole ceiling, and the other to choose a general ceiling colour, not necessarily of high reflectance value, and to fuse into it a highly reflecting colour around the reflecting portion, the exact area of the second colour being a matter for experiment. In determining this, it should be kept in good proportion to the main area, and, incidentally, the proportions of the curved portions of the ceiling forming the reflector should be related to the main shape of the room.

The fundamental aspects of architectural form and proportion have been reviewed in relation to the distribution of light, including the by-product, architectural effects of fittings, and the methods of introducing them. The point has now been reached where lighting may be considered as an adjunct

to decoration. This does not imply that the elements of decoration—colour, texture, and emphasis—would have been excluded from the architect's mind during the earlier considerations. Form and colour are interwoven into an architectural design from the start.

The relating of coloured light to coloured architecture and furnishings is in its infancy. A night at a well-lighted ballet or similar spectacle is convincing, not that stage lighting needs to be employed generally, but as showing that much research remains to be carried out on the effects of coloured light on existing colours, as many disappointed users of the daylight fluorescents will confirm. Tests on the effects of tungsten lighting through various colours and thicknesses of a transparent plastic showed that a disturbingly raw light could emerge from what was a lovely pastel colour in daylight, and that the light passing through blue plastic made flesh not blue and sickly, as might have been expected, but amazingly pink—and too healthy to be true!

In our cold climate it is appropriate that our evening lighting should have

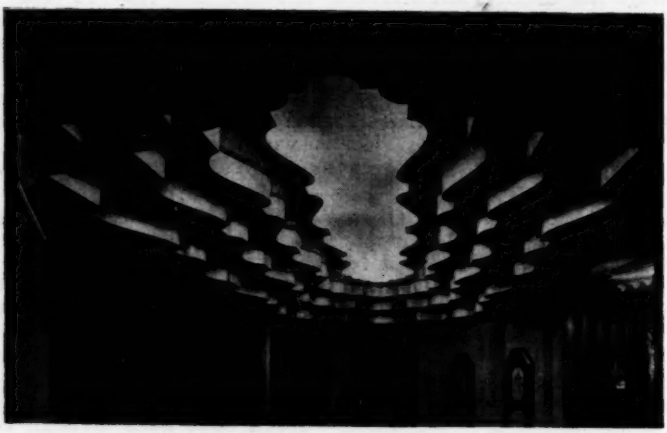

Fig. 5. Architectural form and lighting as an integral part of a design. Suitable only for special purposes, such as cinema foyers.

warm colours, which is precisely what tungsten lighting does. It has been found that generally a colour scheme designed to suit day lighting looks acceptable under artificial light—providing it was acceptable to begin with. However, a long journey lies ahead into the territory of decor and coloured light, and the guidance of knowledgeable engineers would certainly be welcome, together with the results of deeper research, conducted preferably by a team of lighting engineers, colorimetrists and architects.

Texture, an important element in decoration, depends for its effect on shadow and must therefore be carefully lighted, directional lighting being used for important areas of unusual texture if the best effects are to be obtained.

Reveal emphasis was mentioned earlier; most interesting decoration schemes give scope for some point, or points of emphasis. The advent of fluorescent tubes and mirrored reflectors gives emphasis additional importance and it is therefore necessary to employ them with care and discretion.

During the course of this paper, frequent references have been made to the visual characteristics of fittings, but none to their efficiency, construction or

Fig. 6. Good example of indirect scheme where form and lighting are well combined.

materials. The subject is not uninteresting; it is big enough to provide material for a separate paper—an amusing one too, if the law of libel could be waived—but as far as technical efficiency in light production and good construction of fittings are concerned, Lighting Engineers and Manufacturers may speak for themselves.

A much more serious endeavour should be made by designers of fittings to make their forms as simple and attractive as possible. Electric lighting fittings could be in a way examples of new sculptural works designed to meet the growing public appreciation for sculptured form. Manufacturers should accept this as an additional responsibility to that of providing a medium for dispersing light.

Exterior Lighting

While the great majority of lighting problems are conneced with lighting interiors, and in view of the fuel situation exterior lighting should be confined to such portions of the exteriors of buildings as are necessary for public safety, this period may provide a valuable breathing space during which engineers and architects could turn their attention to the whole question of street lighting as an integral part of town design.

It is quite possible the appearance of completely new towns will be entirely different from existing ones, particularly in the matter of continuous street façades, and that as a result of this, their external lighting problems would probably have to be dealt with in two sections—lighting the street and lighting the exterior of the buildings themselves. The existence of continuous façades, however, makes possible the consideration of schemes in which lighting of the street could at the same time take in the illumination of the buildings, although

Fig. 7. Example of architecture of lighting where architectural forms are deliberately influenced by the lighting scheme and where direct lighting is designed as an integral part of the architectural effect.

the begrimed facades of many of our city buildings would form but poor reflectors.

The floodlighting of buildings by light thrown upwards from below, reversing the classic positions of shadows, always seems to give a surprised look to the buildings, rather as though they wished to hide away during the night and did not like to be discovered. The reason is probably that shadows thrown upwards give a wide-eyed effect as distinct from the normal appearance. This may be all very well on State occasions and for isolated buildings, but not for the lighting of the outsides of buildings as part of the scheme of street lighting. This has now been brought much nearer by the advent of the filament free linear lamp, which can be mounted at high level.

Future Possibilities

This recent development is one which will take our eyes from the lighting of architecture to the architecture of lighting, giving compartments in which the whole form may be fundamentally affected by considerations of integral lighting and architecture. Early examples of this are Eric Mendelsohn's Universum at Berlin and Joseph Emberton's Casino at Blackpool. There are probably other examples in this country but they were to some extent handicapped by the fact that lighting came from point sources, whereas, we can now rely on line sources which obviously lend themselves to forms largely composed of straight lines.

The even lighting of surfaces can also now be carried out with much more certainty owing to the development of reflectors for the fluorescent lamp. This architecture of lighting should not be universal in every building and every room; but there are obviously special buildings used mainly at night, such as

places of education and entertainment, in which architecture and lighting may be brought into close relationship. There are also possibilities for individual clients who feel that way about rooms in their own houses.

The architecture of lighting is by now an established trend, though neither formally nor widely established; it is for the architect and the engineer together to pursue this perfectly logical development in the creative sphere of architecture if designs are to be produced worthy to rank as being of our time. Good architecture can ask for nothing more.

In such schemes the architect would go to the engineer saying he had to do this job and felt that he would like certain lighting effects, in the provision of which he was prepared to allow the form to be affected as may be necessary. Can he say how it should be done so as to demonstrate how form and lighting together can be made into something better than either would have been had they been considered separately?

Most architects and engineers agree that such co-operation is desirable; there is much talk of the need for co-operation to-day, but little is heard about the responsibility in co-operation. In pleading for co-operation between architect and engineer, the basis on which they should work together needs examination.

It should be the architect's function to give the engineer a clear picture of the lighting effects required, and then to ask the engineer how they can possibly be achieved. A good lighting scheme should first of all provide the desired level of lighting. This can be left to experts, whose past performances assure their ability to discharge that responsibility quite satisfactorily. The architect is concerned with the way in which the desired level of illumination is produced and the effects of this on the visual qualities of his work. The previously mentioned aspects then need consideration, namely, the interference with spatial characteristics, the relationship in size and shape

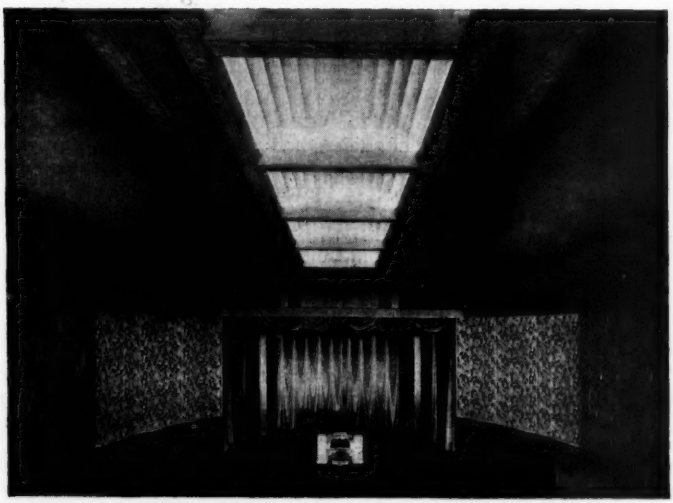

Fig. 8. Example of architectural form over-influenced by considerations of light. The lighting element is so big as to dominate the architectural form of the whole building.

between lighted and unlighted surfaces, the need and place for variety, the importance of fittings as part of the decorative and sculptural effect, and the possibilities of new architectural forms influenced by considerations of artificial light.

Full consideration of these matters can only be given by a team and, on this particular problem, that team is one composed of architect and engineer.

To-day there are many existing buildings where clients will decide they would like a new lighting scheme. Their natural inclination is to ask a firm of lighting engineers or fittings manufacturers to do the job for them. Naturally the customer's wishes with regard to designs of fittings are observed, and he chooses, perhaps uninfluenced by any architectural considerations—and with what results! A parallel process has been taking place for many years in this country where a client has wanted a building, and has immediately thought of the builder. He has gone to the builder, who has produced him his building. Again, with what results! In the past the people concerned may have felt it was not necessary to call in an architect, or, if they did, the job would not have been done better; but Schools of Architecture have for some years been giving architects a much better training than ever they had in the past, and there is on the way a great revival in architectural ability in this country, which in our lifetime will produce works as great as those for which we were justly famous less than two centuries ago.

Whether a building is old or new, whether the original architect has died or cannot be found, whenever engineers are approached to light a building, if they consider it has any architectural character at all, they should advise the client to allow them to consult a reputable architect as to how the building could be lighted to make the most of such character as it may possess. This would undoubtedly bring architects into much closer collaboration, so that whenever they have a building to design where lighting could play an important part, they would instinctively turn to their lighting engineer as surely as they now do to the Ministry of Works to ask whether they are likely to be allowed to go on with the job or not.

Discussion

In opening the discussion, Dr. S. ENGLISH said they had listened to a paper for which some of them had waited for years. In the past, papers from guests outside the ranks of illuminating engineers had not always given the other man's point of view. What often happened was that someone who was asked to write on some architectural, or other aspect of lighting, would go to some of his friends in the lighting industry and say that in a weak moment he had agreed to read a paper on lighting and would they help him in the preparation of the paper. This usually meant that we had retailed to us second, or third-hand, our own story, but Mr. Baine's paper contained his own views, which was exactly what illuminating engineers wanted. In adopting this course there were one or two disadvantages which would have been avoided had Mr. Baines taken the usual course of seeking help from illuminating engineers before writing the paper. For instance, he would not then have used terms which meant something definite to illuminating engineers and given them entirely different meanings from those ordinarily given to them. This applied to Mr. Baines' use of the terms "direct," "indirect," "semi-direct," etc., but we all knew what he meant.

The paper contained one or two "digs" at illuminating engineers, but personally he did not mind that. For instance, reference had been made to the illuminating engineer's fetish for uniform illumination, and in that he thought Mr. Baines was right in his criticism. This opinion was confirmed by a recent

Fig. 1. Inbuilt lighting using Controlens panels at Colston Hall, Bristol. (Since destroyed by fire.)

experiment he had made. An office had been redecorated and relighted so that the brightness ratio did not exceed 3 to 1 throughout the whole office. The illumination was satisfactory, but it was the most miserable and monotonous office to work in. When, in the course of the experiment, big black crosses were placed on the walls to mark the points of measurement of the brightness, the staff agreed that these black patches produced a great improvement in the atmosphere of the room. Therefore, he argued, there should be some variation of light and shade, because uniform brightness did bring about uninteresting monotony.

Having read the paper through more than once and having absorbed some of Mr. Baines' ideas, he had come to the conclusion that some illuminating engineers had been trying to do what was suggested for quite a number of years. They had not put it into words, they were not able to do that with the facility displayed by Mr. Baines, but they had been trying to do something along the lines suggested in the paper and, indeed, there were some installations which might measure up at any rate to a pass standard in Mr. Baines' estimation. For example Fig. 1 was a view of the ill-fated Colston Hall, Bristol, where hanging fittings would have been absolutely fatal. The lighting was designed in conjunction with the architect and the lighting fittings were built into panels in the sides of the Hall so that there was no interference with vision nor with the spatial characteristics of the Hall.

Fig. 2 was a photograph of a School Assembly Hall in which the whole of the fittings had been built into the ceiling structure, and helped to emphasise the architectural features.

Continuing, Dr. English said that Mr. Baines had made a plea for co-operation, and the illuminating engineer was urged to make use of the services of the architect if he did not wish to get abortions as the result of his own efforts. But the reverse was equally necessary! When architects were dealing with the

Fig. 2. Inbuilt lighting at George Watson School, Edinburgh.

lighting of buildings they should go to the illuminating engineer for advice and not try to carry out the lighting without expert advice.

Mr. R. N. WAKELIN said the paper was given the title "The Lighting of Architecture," and it proceeded logically enough from that to the "Architecture of Lighting." Very quickly the author, consciously or unconsciously, departed from his original thesis, and we were suddenly, and for the greater part of the discourse. in the realms of the architecture of lighting. Indeed, with little alteration, the paper could very well have been given under this latter title.

The title "The Lighting of Architecture" pre-supposed that all considerations of function and appearance—in brief, architecture—had been settled, and that the architect then set about the question of lighting the result. Equally, the title might suggest that they were dealing with the problems of existing buildings Apart from this minor point, the author had covered the ground most adequately.

Clearly, the most successful results exampled in the paper were those in which lighting and the sources of lighting were integral parts of the architecture, and had carefully influenced character and form, and this was specially brought out in Figs. 6 and 7. However, the examples quoted were interiors which were not at any time lighted by daylight, and it was possible that architectural form would be less subservient to the dictation of artificial lighting in an interior viewed also by daylight.

Under the heading of Distribution of Light, the author mentioned the charm of variety of light and shade. This, in his view, was the key to successful interior lighting. How often did the engineer, when using indirect cornice lighting, strive to obtain an even distribution of light on the ceiling? Here the engineer was the slave of his training, for he visualised the ceiling as a vast reflector to be used as efficiently as possible. The result of this was to be seen in Fig. 4, where, in spite of Mr. Baines' notes of "repose and architectural

character," the ceiling was entirely divorced from the columns and the entablature. By contrast with Fig. 3, however, the scheme was successful inasmuch as by the otherwise general even illumination, it to some extent neutralised the pronounced architectural form, so that in this case it became a pleasant background for the activities to take place within.

In this connection, another interesting matter was the gradation of light intensities and the effect thereby obtained: at the lower end of the scale of contrast there was an effect of repose, while at the higher end there were effects approaching the dramatic. In a broader way, varying intensities could become complementary to architectural design by gradation in different parts of the building. Lighting often unconsciously followed planning—for example, corridors are less brightly lit than rooms—but its deliberate application was worthy of study. Most architects were familiar with the somewhat dramatic effect of the planned approach to the main room of the building obtained by passing people through the sequence of an entrance hall of medium size and height, then a vestibule relatively small both in plan and height, and thence to the largest and most important room. Here, perhaps, the light intensity could be proportioned to the cubic capacity of the space passed through; medium intensity, then low intensity and, finally, the most brilliant. Perhaps, also, variation in the colour would give good results. This matter of gradation and variation was important, although the even spacing of light fittings in large spaces, such as factories, was sometimes most effective—possibly an architectural effect of visible regularity afforded by the spacing of fittings.

Finally, Mr. Wakelin expressed his appreciation on behalf of his fellow architects present for the very kind welcome given them by the President of the Society.

Mr. J. ASSERSOHN, commenting on the remark in the paper that the imitation of anything was a confession of design failure, said that seemed a little hard because the lighting engineer often tried to imitate, in the interior of a room, the conditions that obtained by day. It seemed to him that the lighting engineer was very largely an imitater by definition.

His next point concerned the author's attack on electric fires that were made to imitate coal fires and which were called shams and unworthy of serious consideration. His own home was fitted throughout with these fires and, as his wife was present, he could see himself faced with a heavy cost of replacing these fires unless he could put up a very convincing argument. Having lived with these fires for some ten years, he could only say he had found them highly satisfactory. Moreover, they appeared to him to look quite nice, and they certainly had the advantage of introducing a focal point in a room in which a coal fire could not be accommodated.

As regards the comment in the paper that glass was an uncomfortable, cold and shiny material, he maintained that it could be made most heartening and attractive, and that it was what lay beyond the glass that determined the effect. With correct illumination from the rear giving a warm glow, a piece of glass could be very attractive.

Speaking of indirect lighting, he agreed as to the possibilities of this form of illumination, but said that maintenance was a very important factor in that it should include the maintenance of the wall or ceiling, whichever served as the reflecting medium. Further, the surface of the reflecting medium must be suitable because, owing to the oblique angle at which the light rays often struck

the reflecting medium, any hollows in the plaster were thrown into sharp relief.

The suggestion that some means should be arrived at for determining the permissible size of fitting relative to the dimensions of the room was a most useful one, and should be a helpful guide to the architect.

Referring to the maintenance of industrial fittings, he said that when factories were lighted by gas-filled lamps in circular reflectors, vitreous enamel was usually employed for the reflecting medium. Nowadays, however, stoved or cellulose enamel was widely used. With the very much larger surfaces encountered in fluorescent fittings, it seemed to him to be a retrograde step to use a finish which was unlikely, over the years, to give satisfactory service.

Mr. F. C. SMITH said that the meeting would probably be interested in British Standards Specification 1381 for "Gas Lighting Units and Fittings for Single Family Dwellings," which had been published recently. This specification contains drawings of suggested designs for fittings, which were contributed by the Council of Industrial Design.

It was not intended that makers of fittings should copy these designs in detail, but they should be of assistance in producing fittings of pleasing design and suitable for mass production.

He felt that fittings designed on these lines would commend themselves to architects.

THE PRESIDENT said that Mr. Baines had coined a very happy phrase when he mentioned "visual as well as photo-electric satisfaction." He felt that this expressed, with almost American picturesqueness, the truth that the eye went much further than the photo-electric photometer and recorded a great many things at the same time—things that were intangible but which he hoped would be appreciated more in the future as a result of this paper.

Continuing, he said he was going to disagree with Mr. Baines in his condemnation of the imitation window, but probably it all depended on what was meant by this phrase. At the N.P.L. they had had to light a building in which there was a long corridor with the ceiling only 7 ft. high. It was impossible to use laylights as the available space was used for other services, and there was very little real daylight except from some small windows with borrowed light from offices. The alternatives were to make use of one of the author's abortions, viz., lamps hanging from the roof; or to put in artificial windows. This latter course was adopted. There were occasions where rooms received no natural light at all and where the artificial window was, he felt, legitimate design. Therefore, whilst he agreed that in, perhaps, 95 per cent. of cases, imitation was a confession of design failure, there was still the remaining 5 per cent. in which a certain form of imitation might be legitimate and, indeed, might be perfectly sound aesthetically.

Dr. H. D. EINHORN, supporting the author's argument against hanging fittings, said that in the early days of illumination when ceilings were high and lamps inefficient, it was necessary to have hanging fittings in order to get enough light on the working plane. To-day, however, ceilings were usually lower and avoidance of glare was a greater problem than the provision of lumens; more use should therefore be made of fittings fixed close to the ceiling.

Mr. Baines had said that the sphere was not ideal for this purpose. Ceiling fittings of other shapes, such as cubes, were architecturally more attractive, but

were difficult to get and very often rather expensive. He suggested that manufacturers should develop a greater variety of ceiling fittings.

MR. ALISTER MACDONALD agreed that many of the ideas put forward in this paper had been in the minds of illuminating engineers for years. They had now been put into black and white, and it was to be hoped that many others, like Dr. English, would read this paper again and again, as one of the links between illuminating engineers and architects. Certainly the paper had given him, as an architect, ideas on how he could better explain himself to electrical engineers. He did not think Mr. Baines need hide his light under a bushel and say he was speaking only for himself. Personally, he would say that Mr. Baines was speaking for all decent minded architects, and he suggested the Society should encourage its various branches throughout the country to invite Mr. Baines to repeat his talk. Together with Mr. Ackerley he had done a number of " circus " turns throughout the country in the past two years, and had found the enthusiasm to be tremendous. It would help both professions if Mr. Baines would also now " take to the road," and follow on.

Mr. R. R. HOLMES, speaking of Mr. Baines's dislike of pendant fittings in relation to the appearance of a room, said it was not an easy matter to give a room in every case a perfect appearance with perfect proportions of height and width. A fitting mounted on the ceiling or in the ceiling would almost invariably give too high a brightness to certain parts of the room where, perhaps, it is not required. Those who were fixed in their ideas that fittings should be on the ceiling or in the ceiling should pay more attention to this greater brightness near the top part of the room and see how it could be avoided if their architectural style or decoration was not to be seen at a disadvantage.

Mr. H. P. WALKER, referring to the statement in the paper regarding the effect of light through a transparent plastic, asked what type of transparent plastic was meant. Certain translucent plastics may have been tried, which were in all probability never designed as transmitters but as reflectors. Even some white opals had bad selective transmissions, and colour made them worse.

A great deal of work had still to be done by the plastics chemist before the best results both for transmitted and reflected light were achieved, and he must not be expected to obtain in six months results which the glass technologist had strived after for 3,000 years.

MR. J. M. WALDRAM said that as one who revelled in diagrams and technicalities he nevertheless welcomed and valued the contribution of the artist. During the war he had many contacts with artists, and it was most refreshing to hear them discussing illuminating engineering problems. Their approach was novel and their observation acute; and they used terms descriptively and impressionistically, with no intention of technical precision. There was a great deal yet to be learned about the way in which we see. We had studied the eye as an organ, and we had studied the physics of light; but we had yet to begin to learn how we used our eyes. It was here that illuminating engineers needed the artist and the architect to help them.

He wished to challenge the statement made in discussion that the illuminating engineer tried to imitate daylight. Personally, he did not think that he did, and if he did, he should not do so. In many side-lit rooms access of daylight was restricted and the distribution very far from uniform; there was no reason to consider it as ideal and no point in imitating its faults. It some-

times happened, however, that the artificial lighting imitated daylight by accident. For example, with indirect lighting they sometimes succeeded, accidentally, in imitating a dull grey day, such as one deplored on a holiday. There was a certain resemblance to such daylight in some of our rather featureless lighting: too much diffusion and too little directional effect might have been at the root of the trouble. Hanging fittings had tended to disappear in America. Sometimes the ceiling had been brought down to the fitting. Whether in doing this the Americans had achieved artistic finality he would not say, but they had certainly achieved interiors in which the space was unencumbered.

MR. J. S. DOW quoted with approval the Author's opinion that artificial lighting need not slavishly imitate daylight. There was, however, the problem of floodlighting. In discussions, architects had occasionally condemned floodlighting on the ground that the light could not strike the building in the same way as daylight. In practice, it was often almost impossible to achieve that condition. Yet in the case of interiors, architects often seemed to ignore that principle, for example local illumination of carved friezes round lecture theatres was often achieved with fluorescent tubing with the natural result that the shadows bore no resemblance to those in daylight—yet it was accepted as good practice!

Another point was the basis on which the amount of illumination in an interior should be judged. In the I.E.S. Code the primary aim was to select an illumination that rendered things visible. The view had been expressed that in certain circumstances that was not the main object; that not only should the fittings be adapted to the surroundings but the whole scale of illumination also, and that in certain cases a subdued illumination was necessary. For example, it was said that period furniture was not meant to be seen completely and should be allowed to remain in partial obscurity. In this connection he recalled the case of a cathedral in which some delightful carving, never before visible, had been revealed by the artificial lighting. Some Ecclesiastical Authorities, however, took the view that it was not meant to be seen and that by making it visible the illuminating engineers were destroying the natural mysticism of the place.

MR. I. M. HEALD asked if the author could give a lead to designers as to the type of fitting required. There were now long light sources in the form of the fluorescent tube which gave five feet of clear light and the point was whether the light source should be used as a light source or as part of the architecture of the building.

MR. BAINES, replying to the discussion, said he was very glad Dr. English called attention to his innocence of engineering terms, but it was a fact that a lighting engineer did effectively help him, though he was not influenced in any way by that help.

In the first slide shown by Dr. English—an indirect lighting scheme of a concert hall—there was a certain amount of diffusion over the surfaces which might tend towards restlessness. Nevertheless, the architecture was well expressed and the effect quite pleasing. The slide of the school assembly hall showed a very satisfactory effect.

He liked the suggestion by Mr. Wakelin and another speaker that intensity of illumination should be varied according to the architectural design. The question of intensity and making things visible emphasised how extraordinarily difficult it is for us to realise what must have been in designers' minds when

there was no artificial light. Then things were conceived in daylight and judged in daylight and even when artificial light was introduced architects reproduced the effects of the past simply because they had the facts before them. These, however, were matters of taste. He had seen period furniture put into the most modern architectural interiors with great effect although it might be regarded as having been taken right out of its natural setting. The answer was good design on the part of all concerned. The most modern lighting effects could successfully live with well-designed period furniture, and he was quite certain that the spirit of the craftsman who carved the ornamentation referred to by Mr. Dow, that was not seen until the illuminating engineer came along, would get a great deal of satisfaction out of that result. Good design of any period would fit in with a good design of some period before—that was the thing to remember. He was pleased that the Council for Industrial Design had co-operated with the British Standards Institution on the design of fittings. He did not know whether all architects would be pleased with the designs, but it was very difficult to draw the line between a specification that dealt with materials and methods and other things affecting appearance. With the co-operation of the Council for Industrial Design it might be all right to let the B.S.I. into the field of design, but he felt that the R.I.B.A. should know something about it.

With regard to the president's point and the odd 5 per cent. of cases where imitation windows might be justified, he felt he ought to give the president that 5 per cent. Every scheme must be treated on its merits and he had no doubt that the 5 per cent. mentioned would have to be dealt with by way of imitation windows. That applied also to plastics. He was sorry that transparency and diffusion got mixed up. His own work had been purely experimental and had not been inflicted on clients. He had not used coloured plastics for the purpose of transmission but as diffusers or reflectors and there, he thought, they had possibilities. The plastic manipulators were putting these materials out now but it was necessary to be careful because there were snags in their use—as he had found out.

He was glad attention had been drawn to the use of suspended fittings in accordance with the size and proportions of the room as he did not wish it to be thought that he condemned them entirely. Recently, he was responsible for a colour scheme in some extremely narrow and high corridors in a hostel. He suggested a colour scheme with the object of drawing down the ceiling. Suspended fittings were used, and although they infringed his own rule, the result was very successful because the suspended fittings gave interest and texture to the high spaces.

With regard to his outlook on artificial lighting and imitation, his view was that the essential difference between artificial and natural lighting was that the former came from the inside while natural lighting came from the outside. Therefore, when imitation windows were installed and illuminated from the outside they were neither windows nor did they give light from the right direction.

With regard to floodlighting and the suggestion that here was inconsistency on the part of architects, he felt he must admit that that was right. If floodlighting was to become a permanent feature then architects would have to think again about the designs of their buildings, but if it was to be for the purpose of occasionally illuminating the building, then the odd appearance must be temporarily accepted.

Regarding the designs of fittings and the 5-ft. fluorescent lamp, he had

found that this type of lamp for domestic interiors was, on the whole, too large in scale, and he made a plea for 2-ft. long units.

Summing up the discussion, he said it confirmed the point made in the early part of the paper stressing the need for close co-operation between the architect and the illuminating engineer.

Additions to List of Members

The following applicants have been duly elected by the Council to membership in the Society, and their names have been added to the list of members:—

SUSTAINING MEMBER:—

Bath Corporation Electricity Dept....*Representative*: Mr. E. A. Newburn. The Old Bridge, Bath.

CORPORATE MEMBERS:—

Baker, W. F. B. .....42, Sandwell Road, BIRMINGHAM, 21.
Bithell, T. .....20, Garden Close, Shoreham-by-Sea, SUSSEX.
Chatterjee, A. .....Lighting Advisory Service, A.E.I. (India), Ltd., 6, Mission Row, Calcutta, INDIA.
Chesters, A. E.....Flat 2, "Dover Cliffs," Egremont Prom., Wallasey, CHES.
Clegg, G. W. .....17, Broad Lane, Burnedge, Rochdale, LANCS.
Cole, L. J. A. .....29, Bath New Road, Radstock, nr. BATH.
Fredericks, F. R. .....41, Linkside, Finchley, N.12.
Furneaux, D. G. .....7, Blenheim Terrace, Redcar, YORKS.
Gunn, W. W.....c.o. British General Electric Co. Pty. Ltd., 104, Clarence street, Sydney, AUSTRALIA.
Huff, R. H. .....35, Windermere Avenue, Brondesbury, N.W.6.
Ilsley, J. L. .....26, Hillside Gardens, Northwood, MIDDX.
Juniper, T. .....2, Royal Buildings, Penarth, GLAM.
Law, G. .....South View, Clayton West, HUDDERSFIELD.
Lowe, L. A. B. ....."Clovelly," 107, Knighton Church Road, LEICESTER.
Mather, D. G. .....2, Union Road, Stockport, CHES.
New, R. C. ....."Merik," Penygroes Avenue, Whitchurch, CARDIFF.
Ovenden, T. M. .....23a, Shandon Drive, Bangor, Co. Down, EIRE.
Pogson, C. .....c.o. Export Dept., Siemens Bros. and Co., Ltd., Woolwich, S.E.18.
Price, W. R. A. .....14, Appleton Road, Middlesbrough, YORKS.
Sheard, E. .....220, Leaventhorpe Lane, Thornton, BRADFORD.
Syne, G. V. .....Burma Railways Head Office (General), Rangoon, BURMA.
Thorpe, N. J. .....45, Southway, Lewes, SUSSEX.
Tooth, G. E. .....Clarendon Cottage, Clarendon Road, Eccles, LANCS.
Truman, D. F. .....10, Buchanan Road, Walsall, STAFFS.
Welch, W. H. .....7, York Road, New Southgate, N.11.
Wilkins, E. L. .....28, Queensborough Terrace, Bayswater, W.2.
Yates, R. T. .....17, Largewood Avenue, Tolworth, SURREY.
Yeates, J. R. .....324, Ditchling Road, Brighton, SUSSEX.

COUNTRY MEMBER:—

Regnier, J. .....16, Bd. Frere Orban, Liege, BELGIUM.

STUDENT MEMBERS:—

Gilbert, A.....25, Cambridge Avenue, Kilburn, N.W.6.
Monery, R. .....35, Trinity Avenue, Bush Hill Park, Enfield, MIDDX.
Pullin, W. M. .....36, Garth Road, Morden, SURREY.
Stockton, C. .....114, Village Way, Beckenham, KENT.

I.E.S. FELLOWSHIP

The following applications for Fellowship have been accepted: W. E. Ballard, J. C. Lowson, W. Robinson, G. A. Wedge, J. A. Whittaker.

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